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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	
32860-000263/US	
U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	
10/019551	

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/01980	June 20, 2000	June 24, 1999

TITLE OF INVENTION
METHOD AND FEED DEVICE FOR EFFECTING THE ADVANCE MOVEMENT OF AT LEAST ONE TOOL SUPPORT THAT ROTATES AROUND A ROTATIONALLY SYMMETRICAL PART

APPLICANT(S) FOR DO/EO/US
Michael LUMM; Jürgen SANDKUHL; and Alfred WAGENFELD

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39 (1).
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau). WO 01/00357 A3
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is transmitted herewith.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4)
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 20. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98-1449 and International Search Report (PCT/ISA/210) in German with Five (5) references.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☒ A substitute specification.
16. ☒ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information:
    1) One (1) sheet of Formal Drawings
    2.) Article 34 Amended Specification and Claims

U.S. APPLICATION NO (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
NEW 10/019551	PCT/DE00/01980	32860-000263/US

21. ☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO. **$1,040.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO. **$710.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4). **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 890.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$ 130.00	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	20 - 20 =	0	X $18.00	$ 0	
Independent Claims	2 - 3 =	0	X $80.00	$ 0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)		None	+ $270.00	$ 0	
		TOTAL OF ABOVE CALCULATIONS =		$ 1,020.00	
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				$ 0	
		SUBTOTAL =		$ 1,020.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐20 ☐30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$ 0	
		TOTAL NATIONAL FEE =		$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
		TOTAL FEES ENCLOSED =		$ 1,020.00	
				Amount to be: refunded	$
				charged	$

a. ☐ A check in the amount of $ _____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account. No. 08-0750 in the amount of $1,020.00 to cover the above fees. A triplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 08-0750.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

Send all correspondence to:
Harness, Dickey & Pierce, P.L.C – Customer No. 30596
Post Office Box 8910
Reston, Virginia 20195

Date: 12/17/01

By _____
Donald J. Daley, #34,313

/kna

PATENT
32860-000263/US

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicants:	Michael LUMM; Jürgen SANDKUHL; and Alfred WAGENFELD
Int'l Application:	PCT/DE00/01980
Application No.:	NEW
Filed:	December 21, 2001
For:	METHOD AND FEED DEVICE FOR EFFECTING THE ADVANCE MOVEMENT OF AT LEAST ONE TOOL SUPPORT THAT ROTATES AROUND A ROTATIONALLY SYMMETRICAL PART

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

December 21, 2001

Sir:

The following preliminary amendments and remarks are respectfully submitted in connection with the above-identified application.

IN THE ABSTRACT

Please replace the Abstract with the attached revised Abstract.

IN THE CLAIMS

Please replace the original claims with the following amended claims:

1. (Amended) A method for carrying out an advancing movement of at least one tool support rotatable about a rotationally symmetric component, the at least one tool being capable of being actuated via a leadscrew, and is supported on the component and rotatably drivable by way of a stationarily mounted main motor via a main transmission mechanism connected to a support of the at least one tool support, an advancing movement of the leadscrew being brought about by a relative movement of a further motor-driven transmission

mechanism cooperating with the leadscrew, in addition to the main transmission mechanism, and a relative movement generated by a drive of a support motor being mounted at a fixed location and for driving the further transmission mechanism, comprising:

synchronously driving the support motor, in rotation as a whole, by the main motor and with the aid of a mechanical coupling of the support and main.

2. (Amended) The method as claimed in claim 1, further comprising braking the support motor in an event of a feed of zero.

3. (Amended) A feed device for a working machine for surface machining of a rotationally symmetric component, comprising:

a stationarily mounted main motor having a main transmission mechanism;

at least one tool support receiving a drive movement from the main transmission mechanism and which rotates about the component;

at least one leadscrew for actuating the at least one tool support;

a support mounting, on the component, for supporting at least the at least one tool support; and

a fixed support motor having a further transmission mechanism for driving at least the at least one leadscrew,

wherein a housing of the support motor is mounted rotatably and is coupled mechanically to the main motor, the support motor being capable of being driven synchronously in rotation by the main motor.

4. (Amended) The feed device as claimed in claim 3, wherein the main transmission mechanism is an externally toothed gear ring driven by a pinion seated on a motor shaft of the main motor.

5. (Amended) The feed device as claimed in claim 3, wherein the main transmission mechanism is an externally toothed gear ring driven by a motor shaft of the main motor via a toothed belt.

6. (Amended) The feed device as claimed in claim 3, wherein the further transmission mechanism is an externally and internally toothed gear ring driven by a pinion seated on a motor shaft of the support motor.

7. (Amended) The feed device as claimed in claim 3, wherein the further transmission mechanism is an externally and internally toothed gear ring driven by the motor shaft of a support motor via a toothed belt.

8. (Amended) The feed device as claimed in claim 3, wherein support motor is equipped with a slip ring set for the transmission of power to windings thereof.

9. (Amended) The feed device as claimed in claim 3, wherein the further transmission mechanism is mounted rotatably on a support of the main motor.

10. (Amended) The feed device as claimed in claim 3, wherein the further transmission mechanism is mounted rotatably on a support mounting of the tool support.

11. (Amended) The feed device as claimed in claim 3, wherein the main motor is coupled mechanically to the housing of the support motor via toothed belts.

12. (Amended) The feed device as claimed in claim 3, wherein the main motor is coupled mechanically to the housing of the support motor via gearwheel mechanisms.

13. (Amended) The feed device as claimed in claim 3, wherein the support motor is a brake motor.

Please add the following new claims:

-- 14. The feed device as claimed in claim 4, wherein the support motor is a brake

motor.

15. The feed device as claimed in claim 5, wherein the support motor is a brake motor.

16. The feed device as claimed in claim 6, wherein the support motor is a brake motor.

17. The feed device as claimed in claim 7, wherein the support motor is a brake motor.

18. The feed device as claimed in claim 4, wherein the further transmission mechanism is an externally and internally toothed gear ring driven by a pinion seated on a motor shaft of the support motor.

19. The feed device as claimed in claim 5, wherein the further transmission mechanism is an externally and internally toothed gear ring driven by the motor shaft of a support motor via a toothed belt.

20. The feed device as claimed in claim 4, wherein the main motor is coupled mechanically to the housing of the support motor via gearwheel mechanisms. --

REMARKS

Claims 1-20 are now present in this application, with new claims 14-20 being added by the present Preliminary Amendment. It should be noted that the amendments to original claims 1-13 of the present application are non-narrowing amendments, made solely to place the claims in proper form for U.S. practice and not to overcome any prior art or for any other statutory considerations. For example, amendments have been made to broaden the claims; remove reference numerals in the claims; remove the European phrase "characterized in that";

remove multiple dependencies in the claims; and to place claims in a more recognizable U.S. form, including the use of the transitional phrase "comprising" as well as the phrase "wherein". Other such non-narrowing amendments include apparatus-type claims (setting elements forth in separate paragraphs) in a more recognizable U.S. form. Again, all amendments are non-narrowing and have been made solely to place the claims in proper form for U.S. practice and not to overcome any prior art or for any other statutory considerations.

SUBSTITUTE SPECIFICATION

In accordance with 37 C.F.R. §1.125, a substitute specification has been included in lieu of substitute paragraphs in connection with the present Preliminary Amendment. The substitute specification is submitted in clean form, attached hereto, and is accompanied by a marked-up version showing the changes made to the original specification. The changes have been made in an effort to place the specification in better form for U.S. practice. No new matter has been added by these changes to the specification. Further, the substitute specification includes paragraph numbers to facilitate amendment practice as requested by the U.S. Patent and Trademark Office.

CONCLUSION

Accordingly, in view of the above amendments and remarks, an early indication of the allowability of each of claims 1-20 in connection with the present application is earnestly solicited.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Donald J. Daley at the telephone number of the undersigned below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

HARNESS, DICKEY & PIERCE, P.L.C

By: _____
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ABSTRACT OF THE DISCLOSURE

A method and apparatus for carrying out an advancing movement of a tool support rotating about a rotationally symmetric component, and an associated feed device, are described. The tool support is capable of being fed via a leadscrew, is supported on a component, and is driven in rotation as a whole by a stationarily mounted main motor via a main transmission mechanism connected firmly to a support of the tool support.

New PCT Application
Docket No. 32860-000263/US
531 Rec'd PCT/PTO 21 DEC 2001

SUBSTITUTE SPECIFICATION

METHOD AND FEED DEVICE FOR EFFECTING THE ADVANCE MOVEMENT OF AT LEAST ONE TOOL SUPPORT THAT ROTATES AROUND A ROTATIONALLY SYMMETRICAL PART

[0001] This application is the national phase under 35 U.S.C. § 371 of PCT International Application No. PCT/DE00/01980 which has an International filing date of June 20, 2000, which designated the United States of America, the entire contents of which are hereby incorporated by reference.

Field of the Invention

[0002] The present invention generally relates to working machines, and more particular, feed devise that act on components.

Background of the Invention

[0003] The machining of large machine shafts, for example turbine and generator shafts, requires special lathes for which large machine sheds are necessary. For working on site, for example for machining the bearing seats during repair by lathe-turning, grinding or polishing, it would be desirable to carry out machining by way of nonstationary machines which can be placed onto the stationary shaft, so that extensive and costly demounting and transport work could be avoided. Even possible damage to the shaft as a result of transport to the place of use itself and also during subsequent installation work often make additional work on the shaft desirable.

[0004] For uses on smaller shafts, lathes are already known which are placed onto a shaft and rotate around the shaft. The problem of such machining appliances is the generation of advance movements for the machining tools in a longitudinal direction and transversely to the shaft. Separate drives which corotate with the lathe have to be used for generating the advancing movements. Apart from the large mass which has to be moved and supported in this way, thus causing vibrations which lead to machining inaccuracies, such an arrangement has further disadvantages. The energy for these drives has to be transmitted to the rotating drives by way of slip rings. The working machine must therefore have an unsplit design, since the slip rings would otherwise also have to be split, but power transmission via split slip rings would present considerable technical difficulties.

[0005] It is desirable, by contrast, for a working machine to be designed to be splittable in order to be placed onto a correspondingly large shaft and for the working machine to be assembled for a machining operation on the shaft, though without requiring power

transmission via split slip rings. Moreover, the rotating mass is to be kept as small as possible.

[0006] A feed device is disclosed in JP-A 62287907, in which the drives for the advancing movements are likewise arranged at a fixed location. The advancing movements take place via the relative movement of a further transmission mechanism cooperating with the respective leadscrew, in addition to the main transmission mechanism. These transmission mechanisms are connected to the main transmission mechanism in each case via a planetary gear, the planet wheels of which can be additionally driven or braked by rest motors and consequently bring about the relative movement. The solution has the disadvantage that planetary gears of this type are highly cost-intensive, and that, particularly in the case of run-on and run-off ramps, internal forces occur which lead to unintended relative movements of the main drive and advancing drive and consequently to unintended adjustments of the machining tools.

SUMMARY OF THE INVENTION

[0007] An object on which the present invention is based is to specify a method for carrying out the advancing movement and a feed device for a working machine with a rotating tool support the method and the feed device allowing machining (lathe-turning, milling, orbital grinding) in NC quality.

[0008] The object is achieved, according to the present invention, by way of the features in at least claims 1 and 3. Expedient refinements of the present invention are contained in the other claims.

[0009] The advancing movement of the tools is generated in that transmission mechanisms are provided, which drive the leadscrews of the tool supports and are themselves driven at a different speed from the working machine which rotates as a whole; the relative speed between the two then takes effect.

[0010] If the relative speed is zero, no advancing movement takes place.

[0011] Preferably, a plurality of large gear rings are provided as transmission mechanisms between the drive motors and the working machine. One of these gear rings is provided for rotating the entire working machine and consequently also determining the cutting speed of a tool with respect to the shaft, while the other gear ring, or gear rings, serves for the advancing movements of the tools.

[0012] When all the gear rings rotate at the same speed, no movement takes place on the cross slide and longitudinal slide supports. Only when the gear rings for the supports for longitudinal and cross movement run more quickly or more slowly than the gear ring driving the working machine, is there a rotation of the leadscrews and therefore an advance of the

supports in relation to the working machine on account of the relation movement between the gear rings. It is therefore necessary to drive the rest motors, which act on the individual gear rings, more quickly or more slowly than the gear ring for the working machine when an advancing movement is to be brought about.

[0013] The gear rings are preferably provided with the same number of external teeth. The pinions driving the gear rings must then have identical diameters. The gear rings for driving the leadscrews are toothed internally and drive the leadscrews of the rests via pinions which are mounted in a rotationally movable manner in the rotating working machine.

[0014] There is a drive motor in each case for driving the gear ring of the rotating working machine and that of the leadscrews. In order to drive all the gear rings synchronously with the main motor in an operating phase in which no advancing movement is to take place, according to the present invention, a mechanical coupling of the main motor to the support motors is provided; for example, via toothed belts, via which the housings of the rest motors are taken up by the main motor. Specifically, in the case described here, at the same rotational speed, the shafts of the rest motors, which are not themselves driven in this operating phase, also being taken up at the same rotational speed and driving the gear rings for the leadscrew movement, so that there is no movement of these gear rings in relation to the gear ring which brings about the rotational movement of the entire working machine. In order at the same time to rule out the effect of internal forces in the working machine, each support motor is expediently braked in this operating phase.

[0015] All the drive motors are arranged at a fixed location, for example directly on the stationary shaft or on a block standing next to the shaft. In this case, the tools controlled by the leadscrews rotate together with the working machine, without executing a relative movement perpendicularly to or along the shaft, as long as the rotational speed of the motor shaft of one or both support motors is not changed in relation to the rotational speed of the driving main motor. Only when, as a result of the switched-on specific drive movement of one of the rest motors, one leadscrew or another rotates more quickly or more slowly than the working machine, about the shaft to be machined, is there a movement of the tool or tools in relation to the shaft. The supply of power to the support motors, the housings of which are fixed in place, but rotate at the same rotational speed as the main motor, takes place via slip rings. The voltage supplied via the slip rings determines the rotational speed of the respective support motor and consequently the advancing speed.

[0016] Instead of lathe tools, other tools may also be used for machining the shaft surface, such as, for example, grinding wheels, milling cutters or polishing devices.

[0017] It is assumed above that all the gear rings and the pinions driving the gear rings have the same diameters and numbers of teeth, and the main motor and the housings of the support

motors have the same rotational speed. This is certainly the most practical solution. It is also possible, however, to use gear rings with different diameters, when the pinions likewise have different diameters and/or the rotational speeds of the motors are not identical. It is important merely that, in the operating state in which no advancing movement is to take place, all the gear rings are driven at the same rotational speed.

[0018] The solution has the advantage that the working machine may have a split design. All the drive motors are to be arranged at a fixed location, and the support motors do not corotate with the entire machine, but only independently. The rotating mass is therefore also kept small. The power transmission to the rest motors may be carried out via unsplit slip rings. A simple and accurate control of the tool supports becomes possible, even in the case of run-on and run-off ramps, and during curve machining of a component to be machined. That is to say surfaces, diameters and curves may be machined, programmed, by way of the NC technique, as in conventional machine tools.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The invention will be explained in more detail below with reference to an exemplary embodiment. In the accompanying drawings:

Fig. 1 shows a diagrammatically illustrated side view of a working machine according to the present invention, and

Fig. 2 shows a top view of the driving side of the working machine according to fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] For the sake of clarity, the exemplary embodiment is preferably an arrangement with two gear rings. That is to say, one gear ring for driving the working machine, and one gear ring for driving a leadscrew for the longitudinal advancing movement of a support. In a practical embodiment of the present invention, at least one third gear ring will be provided for carrying out a second advancing movement of the tool. The embodiments described herein are hereby illustrated in the present invention.

[0021] A working machine is placed onto a shaft 1 to be machined and is supported in a rotationally movable manner on the latter by way of bearings 2. The working machine includes a frame support 3, in which is mounted a tool support 4 that may execute an advancing movement in the longitudinal direction of the shaft 1 via a leadscrew 5. The frame support 3 is designed on the driving side as an externally toothed gear ring 6. Via a pinion 7 on the motor shaft of a main motor 8, the gear ring 6, and therefore also the tool support 4, is driven, so that the latter rotates together with its tool 9, for example a lathe tool, about the

shaft 1. The main motor 8 is in this case fastened on the shaft 1 via a support 10.

[0022] The leadscrew 5 is rotatable in the frame support 3 via a pinion 11 and moves the tool rest 4 back and forth via a worm drive. The pinion 11 is itself driven by an internally an externally toothed gear ring 12 which is mounted rotatably on the frame support 3. As long as the gear rings 6 and 12 do not execute any movement in relation to one another, the tool rest 4 remains in its position, that is to say no advance is brought about. For this purpose, assuming the same number of teeth of a pinion 17 and pinion 7 and of the gear rings 6 and 12, the pinion 17 must be driven at the same rotational speed as the pinion 7. This is carried out by the housing of a support motor 13, on the motor shaft of which the pinion 17 is arranged, being mounted rotatably and rotating with the same rotational speed as the main motor 8 or the pinion 7, the housing taking up the pinion 11 at this rotational speed. In order to bring about rotation and at the same time ensure full synchronism of the two drive movements, the main motor 8 is coupled mechanically to the housing of the support motor 13 via a toothed belt 14.

[0023] In order, in an operating phase without an advancing movement, not to allow any rotational speed of the pinion 17 which deviates from the rotational speed of the housing of the rest motor 13, the rest motor 13 is expediently braked, so that the housing and the motor shaft of the support motor 13 are coupled. In contrast to this, for an advancing movement of the tool rest 4, the brake is released and the rest motor 13 is additionally driven itself. This takes place via the supply of power to slip rings 15 on the rest motor 13. When the rest motor 13 is put into operation, the pinion 17, and consequently the gear ring 12, is additionally driven in one direction or braked in the other direction beyond the rotation that is imparted by the housing of the rest motor 13. A movement of the gear rings 6 and 12 in relation to one another thus takes place, these gear rings bringing about a rotation of the leadscrew 5 and consequently an advance of the tool rest 4.

[0024] Since the rest motor 13, together with its slip ring set, is arranged at a fixed location, the frame support 3 can have a split design, so that it can be placed onto the shaft 1 anywhere on the latter.

[0025] As can easily be seen, a further advancing movement radially relative to the shaft 1 can be achieved by way of a second support motor and a third gear ring and also a conventional deflection mechanism on the tool rest. If further rest drives are also necessary, these can be implemented in the same way.

[0026] The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

~~Description~~

Method and feed device for ~~carrying out~~ effecting the ~~advancing~~ advance movement of at least one tool ~~rest rotating about~~ support that rotates around a rotationally ~~symmetric component~~ symmetrical part

Field of the invention

The machining of large machine shafts, for example turbine and generator shafts, requires special lathes for which large machine sheds are necessary. For working on site, for example for machining the bearing seats during repair by lathe-turning, grinding or polishing, it would be desirable to carry out machining by ~~means~~ way of nonstationary machines which can be placed onto the stationary shaft, so that extensive and costly demounting and transport work could be avoided. Even possible damage to the shaft as a result of transport to the place of use itself and also during subsequent installation work often make additional work on the shaft ~~seem~~ desirable.

Background of the invention

For uses on smaller shafts, lathes are already known which are placed onto a shaft and rotate ~~about~~ around the shaft. The problem of such machining appliances is the generation of ~~advancing~~ advance movements for the machining tools in a longitudinal direction and transversely to the shaft. Separate drives which corotate with the lathe have to be used for generating the advancing movements. Apart from the large mass which has to be moved and supported in this way, thus causing vibrations which lead to machining inaccuracies, such an arrangement has further disadvantages. The energy for these drives has to be transmitted to the rotating drives by ~~means~~ way of slip rings. The working machine must therefore have an unsplit design, since the slip rings would otherwise also have to be split,

but power transmission via split slip rings would present considerable technical difficulties.

It is desirable, by contrast, for a working machine to be designed to be splittable in order to be placed onto a correspondingly large shaft and for the working machine to be assembled for a machining operation on the shaft, though without requiring power transmission via split slip rings. Moreover, the rotating mass is to be kept as small as possible.

is disclosed in
DP-A 62287907 ~~has already disclosed~~ a feed device, in which the drives for the advancing movements are likewise arranged at a fixed location. The advancing movements take place via the relative movement of a further transmission mechanism cooperating with the respective leadscrew, in addition to the main transmission mechanism. These transmission mechanisms are connected to the main transmission mechanism in each case via a planetary gear, the planet wheels of which can be additionally driven or braked by rest motors and consequently bring about the relative movement. The solution has the disadvantage that planetary gears of this type are highly cost-intensive, and that, particularly in the case of run-on and run-off ramps, internal forces occur which lead to unintended relative movements of the main drive and advancing drive and consequently to unintended adjustments of the machining tools.

SUMMARY OF THE INVENTION

~~The~~ present object on which the invention is based is to specify a method for carrying out the advancing movement and a feed device for a working machine with a rotating tool ~~rest~~ support, ~~said~~ the method and ~~said~~ the feed device allowing machining (lathe-turning, milling, orbital grinding) in NC quality.

The object is achieved, according to the present invention, by at least ~~means~~ Way of the features in ~~the characterizing part of~~ claims 1 and 3 ~~in conjunction with the features in the preamble~~. Expedient refinements of the present invention are contained in the ~~subclaims~~ other claims.

The advancing movement of the tools is generated in that transmission mechanisms are provided, which drive the leadscrews of the tool ~~rests~~ supports and are themselves driven at a different speed from the working machine which rotates as a whole; the relative speed between the two then takes effect.

If the relative speed is zero, no advancing movement takes place.

Preferably, a plurality of large gear rings are provided as transmission mechanisms between the drive motors and the working machine, one of these gear rings being provided for rotating the entire working machine and consequently also determining the cutting speed of a tool with respect to the shaft, while the other gear ring, or gear rings, serves or serve for the advancing movements of the tools.

When all the gear rings rotate at the same speed, no movement takes place on the cross slide and longitudinal slide rests. Only when the gear rings for the rests for longitudinal and cross movement run more quickly or more slowly than the gear ring driving the working machine, is there a rotation of the leadscrews and therefore an advance of the rests in relation to the working machine on account of the relation movement between the gear rings. It is therefore necessary to drive the rest motors, which act on the individual gear rings, more quickly or more slowly than the gear ring for the working machine when an advancing movement is to be brought about.

The gear rings are preferably provided with the same number of external teeth. The pinions driving the gear rings must then have identical diameters. The gear rings for driving the leadscrews are toothed internally and drive the leadscrews of the rests via pinions which are mounted in a rotationally movable manner in the rotating working machine.

There is a drive motor in each case for driving the gear ring of the rotating working machine and that of the leadscrews. In order to drive all the gear rings synchronously with the main motor in an operating phase in which no advancing movement is to take place, according to the present invention, a mechanical coupling of the main motor to the ~~rest~~ support motors is provided, for example, via toothed belts, via which the housings of the rest motors are taken up by the main motor. Specifically, in the case described here, at the same rotational speed, the shafts of the rest motors, which are not themselves driven in this operating phase, also being taken up at the same rotational speed and driving the gear rings for the leadscrew movement, so that there is no movement of these gear rings in relation to the gear ring which brings about the rotational movement of the entire working machine. In order at the same time to rule out the effect of internal forces in the working machine, each ~~rest~~ support motor is expediently braked in this operating phase.

All the drive motors are arranged at a fixed location, for example directly on the stationary shaft or on a block standing next to the shaft. In this case, the tools controlled by the leadscrews rotate together with the working machine, without executing a relative movement perpendicularly to or along the shaft, as long as the rotational speed of the motor shaft of one or both ~~rest~~ support motors is not changed in relation to the rotational speed of the driving main motor. Only when, as a result of the switched-on specific drive movement of one of the rest motors, one leadscrew or another rotates more quickly or more slowly than the working machine, about the shaft to be machined, is there a movement of the tool or tools in relation to the shaft. The supply of power to the ~~rest~~ support motors, the housings of which are fixed in place, but rotate at the same rotational speed as the main motor, takes place via slip rings.

The voltage supplied via the slip rings determines the rotational speed of the respective support motor and consequently the advancing speed.

Instead of lathe tools, other tools may also be used for machining the shaft surface, such as, for example, grinding wheels, milling cutters or polishing devices.

It is assumed above that all the gear rings and the pinions driving these gear rings have the same diameters and numbers of teeth, and the main motor and the housings of the support motors have the same rotational speed. This is certainly the most practical solution. It is also possible, however, to use gear rings with different diameters, when the pinions likewise have different diameters and/or the rotational speeds of the motors are not identical. It is important merely that, in the operating state in which no advancing movement is to take place, all the gear rings are driven at the same rotational speed.

The solution has the advantage that the working machine may have a split design. All the drive motors are to be arranged at a fixed location, and the support motors do not corotate with the entire machine, but only independently. The rotating mass is therefore also kept small. The power transmission to the rest motors may be carried out via unsplit slip rings. A simple and accurate control of the tool supports becomes possible, even in the case of run-on and run-off ramps, and during curve machining of the component to be machined, that is to say surfaces, diameters and curves may be machined, programmed, by way of the NC technique, as in conventional machine tools.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be explained in more detail below with reference to an exemplary embodiment. In the accompanying drawings:

fig. 1 shows a diagrammatically illustrated side view of a working machine according to the present invention, and

fig. 2 shows a top view of the driving side of the working machine according to fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

For the sake of clarity, the exemplary embodiment is ~~restricted to~~ Perhaps an arrangement with two gear rings, that is to say one gear ring for driving the working machine, ~~as such~~ and one gear ring for driving a leadscrew for the longitudinal advancing movement of a ~~rest~~ support. In ~~the~~ a practical ~~version~~ embodiment of the present invention, at least one third gear ring will be provided for carrying out a second advancing movement of the tool. The embodiments described here in are merely illustrated of the present invention

~~The~~ A working machine is placed onto a shaft 1 to be machined and is supported in a rotationally movable manner on the latter by ~~means~~ way of bearings 2. ~~It~~ The working machine ~~consists of~~ includes a frame support 3, in which is mounted a tool ~~rest~~ support 4 ~~which can~~ that may execute an advancing movement in the longitudinal direction of the shaft 1 via a leadscrew 5. The frame support 3 is designed on the driving side as an externally toothed gear ring 6. Via a pinion 7 on the motor shaft of a main motor 8, the gear ring 6, and therefore also the tool ~~rest~~ support 4, is driven, so that the latter rotates together with its tool 9, for example a lathe tool, about the shaft 1. The main motor 8 is in this case fastened on the shaft 1 via a support 10.

The leadscrew 5 is rotatable in the frame support 3 via a pinion 11 and moves the tool rest 4 back and forth via a worm drive. The pinion 11 is itself

driven by an internally an externally toothed gear ring 12 which is mounted rotatably on the frame support 3. As long as the gear rings 6 and 12 do not execute any movement in relation to one another, the tool rest 4 remains in its position, that is to say no advance is brought about. For this purpose, assuming the same number of teeth of ~~the~~ a pinion 17 and pinion 7 and of the gear rings 6 and 12, the pinion 17 must be driven at the same rotational speed as the pinion 7. This is carried out by the housing of a ~~rest~~ support motor 13, on the motor shaft of which the pinion 17 is arranged, being mounted rotatably and rotating with the same rotational speed as the main motor 8 or the pinion 7, ~~said~~ the housing taking up the pinion 11 at this rotational speed. In order to bring about rotation and at the same time ensure full synchronism of the two drive movements, the main motor 8 is coupled mechanically to the housing of the ~~rest~~ support motor 13 via a toothed belt 14.

In order, in an operating phase without an advancing movement, not to allow any rotational speed of ~~its~~ the pinion 17 which deviates from the rotational speed of the housing of the rest motor 13, the rest motor 13 is expediently braked, so that the housing and the motor shaft of the ~~rest~~ support motor 13 are coupled. In contrast to this, for an advancing movement of the tool rest 4, the brake is released and the rest motor 13 is additionally driven itself. This takes place via the supply of power to slip rings 15 on the rest motor 13. When the rest motor 13 is put into operation, the pinion 17, and consequently the gear ring 12, is additionally driven in one direction or braked in the other direction beyond the rotation ~~which~~ that is imparted by the housing of the rest motor 13. A movement of the gear rings 6 and 12 in relation to one another thus takes place, these gear rings bringing about a rotation of the leadscrew 5 and consequently an advance of the tool rest 4.

Since the rest motor 13, together with its slip ring set, is arranged at a fixed location, the frame support 3 can have a split design, so that it can be placed onto the shaft 1 anywhere on the latter.

As can easily be seen, a further advancing movement radially relative to the shaft 1 can be achieved by ~~means~~ carry of a second rest motor and a third gear ring and also a conventional deflection mechanism on the tool rest. If further ~~rest~~ support drives are also necessary, these can be implemented in the same way.

Variations FP

Abstract

Method and feed device for carrying out the advancing movement of at least one tool rest rotating about a rotationally symmetric component

A method for carrying out the advancing movement of one or more tool rests rotating about a rotationally symmetric component and an associated feed device are described. The rests are capable in each case of being fed via a leadscrew, are supported on the component and are driven in rotation as a whole by a stationarily mounted main motor via a main transmission mechanism connected firmly to the support of the tool rest or tool rests. Rotating working machines of this type have hitherto operated with a large rotating mass. Moreover, it would be desirable for the machine to be capable of having a splittable design in order to be placed onto a component.

According to the method, there is provision for the advancing movement of each leadscrew to be brought about by the relative movement of a further motor-driven transmission mechanism cooperating with the leadscrew, in addition to the main transmission mechanism.

The relative movement is achieved by means of a feed device, in which each leadscrew (5) is capable of being driven by a further transmission mechanism and the latter by a fixed rest motor (13), the housing of which is mounted rotatably and coupled mechanically to the main motor (8) and is thus capable of being driven synchronously in rotation by the latter.

The solution is provided, in particular, for the machining of large shafts on site.

FIG 1

Patent Claims

1. A method for carrying out ~~the~~ an advancing movement of at least one tool ~~rest~~ support ~~rotating~~ rotatable about a rotationally symmetric component, ~~and which is~~ the at least one tool being capable of being ~~fed in each case~~ actuated via a leadscrew, and is supported on the component and ~~is driven in rotation as a whole~~ rotatably drivable by way of a stationarily mounted main motor via a main transmission mechanism connected ~~firmly~~ at least one support to ~~the~~ a support of the tool ~~rest or tool rests~~, ~~the~~ an actuation/advancing movement of ~~each~~ the leadscrew being brought about ~~in each case~~ by ~~the~~ a relative movement of a further motor-driven transmission mechanism cooperating with the leadscrew, in addition to the main transmission mechanism, and ~~the~~ a relative movement generated by ~~the~~ a drive ~~in each case of~~ a ~~rest~~ support motor being mounted at a fixed location and for driving the further transmission mechanism, ~~characterized in that~~ comprising: the ~~rest~~ motor, ~~is synchronously driven~~ synchronously driving in rotation as a whole, by the main motor with the aid of a mechanical coupling ~~to the latter~~ of the rest and main motors.

2. The method as claimed in claim 1, ~~characterized in that each~~ further comprising braking the support ~~rest~~ motor ~~is braked~~ in ~~the~~ an event of a feed of zero.

3. A feed device for a working machine for ~~the~~ surface machining of a rotationally symmetric component, ~~(1), with~~ comprising: a stationarily mounted main motor ~~(8) and with~~ having a main transmission mechanism ~~for transmitting the drive movement from the main motor (8) to~~ for receiving a drive movement from the main transmission mechanism and at least one tool ~~rest~~ support ~~(4)~~ which rotates about the component, ~~(1) and is capable of being fed on~~ at least one leadscrew ~~(5) and which is supported by means of~~ a ~~rest~~ support mounting ~~(3) on~~ for actuating the at least one tool support on the component;

~~the component~~ (1), each leadscrew (5)

being capable of being driven by a further transmission mechanism and the latter by a fixed rest motor (13), characterized in that the housing of the rest motor (13) is mounted rotatably and is coupled mechanically to the main motor, (8) and is thus capable of being driven synchronously in rotation by the latter.

4. The feed device as claimed in claim 3, characterized in that the main transmission mechanism is an externally toothed gear ring (6) driven by a pinion (7) seated on the motor shaft of the main motor (8).

5. The feed device as claimed in claim 3 or 4, characterized in that the main transmission mechanism is an externally toothed gear ring driven by the motor shaft of the main motor via a toothed belt.

6. The feed device as claimed in one of claims 3 to 5, characterized in that the further transmission mechanism is an externally and internally toothed gear ring (12) driven by a pinion (11) seated on the motor shaft of the rest motor (13).

7. The feed device as claimed in one of claims 3 to 6, characterized in that the further transmission mechanism is an externally and internally toothed gear ring driven by the motor shaft of the rest motor via a toothed belt.

8. The feed device as claimed in ~~one of claims 3 to 7, characterized in that each rest~~ claim 3, wherein the SUPPORT motor (~~13~~) is equipped with a slip ring set (~~15~~) for the transmission of power to ~~its~~ windings thereof

9. The feed device as claimed in ~~one of claims 3 to 8, characterized in that~~ claim 3, wherein the further transmission mechanism is mounted rotatably on a support (~~10~~) of the main motor (~~8~~).

10. The feed device as claimed in ~~one of claims 3 to 8, characterized in that~~ claim 3, wherein the further transmission mechanism is mounted rotatably on ~~the~~ La rest SUPPORT mounting (~~3~~) of the tool ~~rest (4)~~ SUPPORT.

11. The feed device as claimed in ~~one of claims 3 to 10, characterized in that~~ claim 3, wherein the main motor (~~8~~) is coupled mechanically to ~~the~~ or housing of the ~~rest~~ SUPPORT motor ~~or rest motors~~ (13) via toothed belts (14).

12. The feed device as claimed in ~~one of claims 3 to~~ claim 3, wherein 10, characterized in that the main motor is coupled mechanically to the housing of the ~~rest~~ SUPPORT motor ~~or rest motors~~ via gearwheel mechanisms.

13. The feed device as claimed in ~~one of claims 3 to 12, characterized in that~~ claim 3, wherein the ~~rest~~ SUPPORT motor (~~13~~) is a brake motor.

14. same as 13, depending on 4 20. same as 12, depending on 4

15 " " " 5

16 " " " 6

17 " " " 7

18 same as 6, depending on 4

19 " " 7 " " 5

Reference Symbols

1	Shaft
2	Bearing
3	Frame support
4	Tool rest
5	Leadscrew
6	Ring gear
7	Pinion
8	Main motor
9	Tool
10	Support
11	Pinion
12	Ring gear
13	Rest motor
14	Toothed belt
15	Slip rings
17	Pinion

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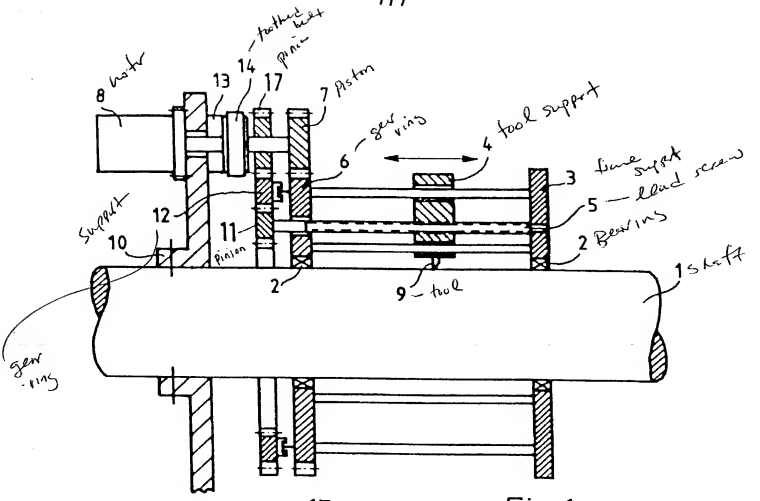

Fig. 1

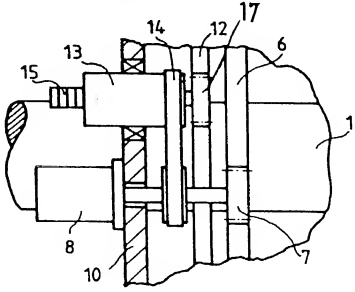

Fig. 2

Description

Method and feed device for carrying out the advancing movement of at least one tool rest rotating about a rotationally symmetric component

The machining of large machine shafts, for example turbine and generator shafts, requires special lathes for which large machine sheds are necessary. For working on site, for example for machining the bearing seats during repair by lathe-turning, grinding or polishing, it would be desirable to carry out machining by means of nonstationary machines which can be placed onto the stationary shaft, so that extensive and costly demounting and transport work could be avoided. Even possible damage to the shaft as a result of transport to the place of use itself and also during subsequent installation work often make additional work on the shaft seem desirable.

For uses on smaller shafts, lathes are already known which are placed onto a shaft and rotate about the shaft. The problem of such machining appliances is the generation of advancing movements for the machining tools in a longitudinal direction and transversely to the shaft. Separate drives which corotate with the lathe have to be used for generating the advancing movements. Apart from the large mass which has to be moved and supported in this way, thus causing vibrations which lead to machining inaccuracies, such an arrangement has further disadvantages. The energy for these drives has to be transmitted to the rotating drives by means of slip rings. The working machine must therefore have an unsplit design, since the slip rings would otherwise also have to be split,

but power transmission via split slip rings would present considerable technical difficulties.

It is desirable, by contrast, for a working machine to be designed to be splittable in order to be placed onto a correspondingly large shaft and for the working machine to be assembled for a machining operation on the shaft, though without requiring power transmission via split slip rings. Moreover, the rotating mass is to be kept as small as possible.

JP-A 62287907 has already disclosed a feed device, in which the drives for the advancing movements are likewise arranged at a fixed location. The advancing movements take place via the relative movement of a further transmission mechanism cooperating with the respective leadscrew, in addition to the main transmission mechanism. These transmission mechanisms are connected to the main transmission mechanism in each case via a planetary gear, the planet wheels of which can be additionally driven or braked by rest motors and consequently bring about the relative movement. The solution has the disadvantage that planetary gears of this type are highly cost-intensive, and that, particularly in the case of run-on and run-off ramps, internal forces occur which lead to unintended relative movements of the main drive and advancing drive and consequently to unintended adjustments of the machining tools.

The object on which the invention is based is to specify a method for carrying out the advancing movement and a feed device for a working machine with a rotating tool rest, said method and said feed device allowing machining (lathe-turning, milling, orbital grinding) in NC quality.

The object is achieved, according to the invention, by means of the features in the characterizing part of claims 1 and 3 in conjunction with the features in the preamble. Expedient refinements of the invention are contained in the subclaims.

The advancing movement of the tools is generated in that transmission mechanisms are provided, which drive the leadscrews of the tool rests and are themselves driven at a different speed from the working machine which rotates as a whole; the relative speed between the two then takes effect.

If the relative speed is zero, no advancing movement takes place.

Preferably a plurality of large gear rings are provided as transmission mechanisms between the drive motors and the working machine, one of these gear rings being provided for rotating the entire working machine and consequently also determining the cutting speed of a tool with respect to the shaft, while the other gear ring or gear rings serves or serve for the advancing movements of the tools.

When all the gear rings rotate at the same speed, no movement takes place on the cross slide and longitudinal slide rests. Only when the gear rings for the rests for longitudinal and cross movement run more quickly or more slowly than the gear ring driving the working machine is there a rotation of the leadscrews and therefore an advance of the rests in relation to the working machine on account of the relation movement between the gear rings. It is therefore necessary to drive the rest motors, which act on the individual gear rings, more quickly or more slowly than the gear ring for the working machine when an advancing movement is to be brought about.

The gear rings are preferably provided with the same number of external teeth. The pinions driving the gear rings must then have identical diameters. The gear rings for driving the leadscrews are toothed internally and drive the leadscrews of the rests via pinions which are mounted in a rotationally movable manner in the rotating working machine.

There is a drive motor in each case for driving the gear ring of the rotating working machine and that of the leadscrews. In order to drive all the gear rings synchronously with the main motor in an operating phase in which no advancing movement is to take place, according to the invention a mechanical coupling of the main motor to the rest motors is provided, for example via toothed belts, via which the housings of the rest motors are taken up by the main motor, specifically, in the case described here, at the same rotational speed, the shafts of the rest motors, which are not themselves driven in this operating phase, also being taken up at the same rotational speed and driving the gear rings for the leadscrew movement, so that there is no movement of these gear rings in relation to the gear ring which brings about the rotational movement of the entire working machine. In order at the same time to rule out the effect of internal forces in the working machine, each rest motor is expediently braked in this operating phase.

All the drive motors are arranged at a fixed location, for example directly on the stationary shaft or on a block standing next to the shaft. In this case, the tools controlled by the leadscrews rotate together with the working machine, without executing a relative movement perpendicularly to or along the shaft, as long as the rotational speed of the motor shaft of one or both rest motors is not changed in relation to the rotational speed of the driving main motor. Only when, as a result of the switched-on specific drive movement of one of the rest motors, one leadscrew or another rotates more quickly or more slowly than the working machine about the shaft to be machined is there a movement of the tool or tools in relation to the shaft. The supply of power to the rest motors, the housings of which are fixed in place, but rotate at the same rotational speed as the main motor, takes place via slip rings,

the voltage supplied via the slip rings determining the rotational speed of the respective rest motor and consequently the advancing speed.

Instead of lathe tools, other tools may also be used for machining the shaft surface, such as, for example, grinding wheels, milling cutters or polishing devices.

It was assumed above that all the gear rings and the pinions driving these have the same diameters and numbers of teeth and the main motor and the housings of the rest motors have the same rotational speed. This is certainly the most practical solution. It is also possible, however, to use gear rings with different diameters, when the pinions likewise have different diameters and/or the rotational speeds of the motors are not identical. It is important merely that, in the operating state in which no advancing movement is to take place, all the gear rings are driven at the same rotational speed.

The solution has the advantage that the working machine can have a split design. All the drive motors are to be arranged at a fixed location, and the rest motors do not corotate with the entire machine, but only independently. The rotating mass is therefore also kept small. The power transmission to the rest motors can be carried out via unsplit slip rings. A simple and accurate control of the tool rests becomes possible, even in the case of run-on and run-off ramps and during curve machining of the component to be machined, that is to say surfaces, diameters and curves can be machined, programmed, by means of the NC technique, as in conventional machine tools.

The invention will be explained in more detail below with reference to an exemplary embodiment. In the accompanying drawings:

fig. 1 shows a diagrammatically illustrated side view of a working machine according to the invention, and

fig. 2 shows a top view of the driving side of the working machine according to fig. 1.

For the sake of clarity, the exemplary embodiment is restricted to an arrangement with two gear rings, that is to say one for driving the working machine as such and one for driving a leadscrew for the longitudinal advancing movement of a rest. In the practical version, at least one third gear ring will be provided for carrying out a second advancing movement of the tool.

The working machine is placed onto a shaft 1 to be machined and is supported in a rotationally movable manner on the latter by means of bearings 2. It consists of a frame support 3, in which is mounted a tool rest 4 which can execute an advancing movement in the longitudinal direction of the shaft 1 via a leadscrew 5. The frame support 3 is designed on the driving side as an externally toothed gear ring 6. Via a pinion 7 on the motor shaft of a main motor 8, the gear ring 6, and therefore also the tool rest 4, is driven, so that the latter rotates together with its tool 9, for example a lathe tool, about the shaft 1. The main motor 8 is in this case fastened on the shaft 1 via a support 10.

The leadscrew 5 is rotatable in the frame support 3 via a pinion 11 and moves the tool rest 4 back and forth via a worm drive. The pinion 11 is itself

driven by an internally an externally toothed gear ring 12 which is mounted rotatably on the frame support 3. As long as the gear rings 6 and 12 do not execute any movement in relation to one another, the tool rest 4 remains in its position, that is to say no advance is brought about. For this purpose, assuming the same number of teeth of the pinion 17 and pinion 7 and of the gear rings 6 and 12, the pinion 17 must be driven at the same rotational speed as the pinion 7. This is carried out by the housing of a rest motor 13, on the motor shaft of which the pinion 17 is arranged, being mounted rotatably and rotating with the same rotational speed as the main motor 8 or the pinion 7, said housing taking up the pinion 11 at this rotational speed. In order to bring about rotation and at the same time ensure full synchronism of the two drive movements, the main motor 8 is coupled mechanically to the housing of the rest motor 13 via a toothed belt 14.

In order, in an operating phase without an advancing movement, not to allow any rotational speed of its pinion 17 which deviates from the rotational speed of the housing of the rest motor 13, the rest motor 13 is expediently braked, so that the housing and the motor shaft of the rest motor 13 are coupled. In contrast to this, for an advancing movement of the tool rest 4, the brake is released and the rest motor 13 is additionally driven itself. This takes place via the supply of power to slip rings 15 on the rest motor 13. When the rest motor 13 is put into operation, the pinion 17, and consequently the gear ring 12, is additionally driven in one direction or braked in the other direction beyond the rotation which is imparted by the housing of the rest motor 13. A movement of the gear rings 6 and 12 in relation to one another thus takes place, these gear rings bringing about a rotation of the leadscrew 5 and consequently an advance of the tool rest 4.

Since the rest motor 13, together with its slip ring set, is arranged at a fixed location, the frame support 3 can have a split design, so that it can be placed onto the shaft 1 anywhere on the latter.

As can easily be seen, a further advancing movement radially relative to the shaft 1 can be achieved by means of a second rest motor and a third gear ring and also a conventional deflection mechanism on the tool rest. If further rest drives are also necessary, these can be implemented in the same way.

Patent Claims

1. A method for carrying out the advancing movement of at least one tool rest rotating about a rotationally symmetric component and which is capable of being fed in each case via a leadscrew, is supported on the component and is driven in rotation as a whole by a stationarily mounted main motor via a main transmission mechanism connected firmly to the support of the tool rest or tool rests, the advancing movement of each leadscrew being brought about in each case by the relative movement of a further motor-driven transmission mechanism cooperating with the leadscrew, in addition to the main transmission mechanism, and the relative movement generated by the drive in each case of a rest motor mounted at a fixed location and driving the further transmission mechanism, characterized in that the rest motor is synchronously driven in rotation as a whole by the main motor with the aid of a mechanical coupling to the latter.

2. The method as claimed in claim 1, characterized in that each rest motor is braked in the event of a feed of zero.

3. A feed device for a working machine for the surface machining of rotationally symmetric components (1), with a stationarily mounted main motor (8) and with a main transmission mechanism for transmitting the drive movement from the main motor (8) to at least one tool rest (4) which rotates about the component (1) and is capable of being fed on at least one leadscrew (5), and which is supported by means of a rest mounting (3) on

the component (1), each leadscrew (5)

being capable of being driven by a further transmission mechanism and the latter by a fixed rest motor (13), characterized in that the housing of the rest motor (13) is mounted rotatably and is coupled mechanically to the main motor (8) and is thus capable of being driven synchronously in rotation by the latter.

4. The feed device as claimed in claim 3, characterized in that the main transmission mechanism is an externally toothed gear ring (6) driven by a pinion (7) seated on the motor shaft of the main motor (8).

5. The feed device as claimed in claim 3 or 4, characterized in that the main transmission mechanism is an externally toothed gear ring driven by the motor shaft of the main motor via a toothed belt.

6. The feed device as claimed in one of claims 3 to 5, characterized in that the further transmission mechanism is an externally and internally toothed gear ring (12) driven by a pinion (11) seated on the motor shaft of the rest motor (13).

7. The feed device as claimed in one of claims 3 to 6, characterized in that the further transmission mechanism is an externally and internally toothed gear ring driven by the motor shaft of the rest motor via a toothed belt.

8. The feed device as claimed in one of claims 3 to 7, characterized in that each rest motor (13) is equipped with a slip ring set (15) for the transmission of power to its windings.

9. The feed device as claimed in one of claims 3 to 8, characterized in that the further transmission mechanism is mounted rotatably on a support (10) of the main motor (8).

10. The feed device as claimed in one of claims 3 to 8, characterized in that the further transmission mechanism is mounted rotatably on the rest mounting (3) of the tool rest (4).

11. The feed device as claimed in one of claims 3 to 10, characterized in that the main motor (8) is coupled mechanically to the housing of the rest motor or rest motors (13) via toothed belts (14).

12. The feed device as claimed in one of claims 3 to 10, characterized in that the main motor is coupled mechanically to the housing of the rest motor or rest motors via gearwheel mechanisms.

13. The feed device as claimed in one of claims 3 to 12, characterized in that the rest motor (13) is a brake motor.

Reference symbols

1	Shaft
2	Bearing
3	Frame support
4	Tool rest
5	Leadscrew
6	Ring gear
7	Pinion
8	Main motor
9	Tool
10	Support
11	Pinion
12	Ring gear
13	Rest motor
14	Toothed belt
15	Slip rings
17	Pinion

Abstract

Method and feed device for carrying out the advancing movement of at least one tool rest rotating about a rotationally symmetric component

A method for carrying out the advancing movement of one or more tool rests rotating about a rotationally symmetric component and an associated feed device are described. The rests are capable in each case of being fed via a leadscrew, are supported on the component and are driven in rotation as a whole by a stationarily mounted main motor via a main transmission mechanism connected firmly to the support of the tool rest or tool rests. Rotating working machines of this type have hitherto operated with a large rotating mass. Moreover, it would be desirable for the machine to be capable of having a splittable design in order to be placed onto a component.

According to the method, there is provision for the advancing movement of each leadscrew to be brought about by the relative movement of a further motor-driven transmission mechanism cooperating with the leadscrew, in addition to the main transmission mechanism.

The relative movement is achieved by means of a feed device, in which each leadscrew (5) is capable of being driven by a further transmission mechanism and the latter by a fixed rest motor (13), the housing of which is mounted rotatably and coupled mechanically to the main motor (8) and is thus capable of being driven synchronously in rotation by the latter.

The solution is provided, in particular, for the machining of large shafts on site.

FIG 1

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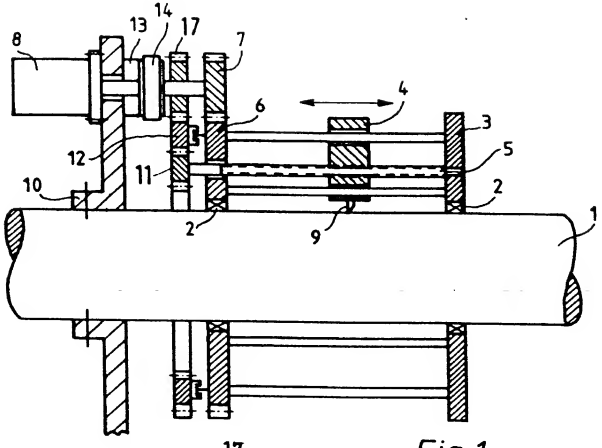

Fig. 1

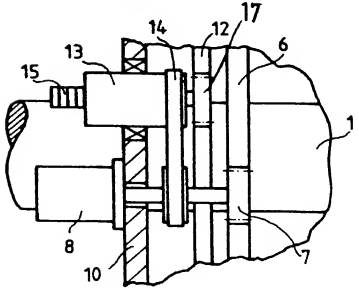

Fig. 2

Declaration and Power of Attorney For Patent Application

Erklärung Für Patentanmeldungen Mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehöngkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Verfahren und Zustelleinrichtung zur Realisierung der Vorschubbewegung mindestens eines um ein rotationssymmetrisches Bauteil umlaufenden Werkzeugsupports

METHOD AND ADVANCE DEVICE FOR EFFECTING THE ADVANCE MOVEMENT OF AT LEAST ONE TOOL SUPPORT THAT ROTATES AROUND A ROTATIONALLY SYMMETRICAL PART

deren Beschreibung

the specification of which

(zutreffendes ankreuzen)
☐ hier beigefügt ist.
☒ am 20.06.2000 als
PCT internationale Anmeldung
PCT Anmeldungsnummer PCT/DE00/01980
eingereicht wurde und am _____
abgeandert wurde (falls tatsächlich abgeändert).

(check one)
☐ is attached hereto.
☒ was filed on 20.06.2000 as
PCT international application
PCT Application No. PCT/DE00/01980
and was amended on _____
(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Ich beanspruche hiermit ausländische Prioritatsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen fur ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

German Language Declaration

Prior foreign applications
Priorität beansprucht

			Priority Claimed	
19929712.6	DE	24.06.1999	☒	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein
			☐	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein
			☐	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/01980	20.06.2000		pending
(Application Serial No)	(Filing Date D, M, Y)	(Status)	(Status)
(Anmeldeseriennummer)	(Anmeldedatum T, M, J)	(patentiert, anhangig, aufgegeben)	(patented, pending, abandoned)
(Application Serial No)	(Filing Date D,M,Y)	(Status)	(Status)
(Anmeldeseriennummer)	(Anmeldedatum T, M, J)	(patentiert, anhangig, aufgeben)	(patented, pending, abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

VERTRETUNGSVOLLMACHT: Als benannter Erfinder beauftrage ich hiermit den nachstehend benannten Patentanwalt (oder die nachstehend benannten Patentanwälte) und/oder Patent-Agenten mit der Verfolgung der vorliegenden Patentanmeldung sowie mit der Abwicklung aller damit verbundenen Geschäfte vor dem Patent- und Warenzeichenamt: *(Name und Registrationsnummer anführen)*

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

And I hereby appoint

Customer No. 30596

Telefongespräche bitte richten an: *(Name und Telefonnummer)*

Direct Telephone Calls to: *(name and telephone number)*

Ext. _____

Postanschrift:

Send Correspondence to:

Harness, Dickey & Pierce, P.L.C.
12355 Sunrise Valley Drive, Suite 350 20191 ~~Reston, Va.~~
Telephone: +1 703 390 3030 and Facsimile +1 703 390 3020

or

Customer No. 30596

Voller Name des einzigen oder ursprünglichen Erfinders	Full name of sole or first inventor
MICHAEL LUMM	MICHAEL LUMM
Unterschrift des Erfinders Datum	Inventor's signature Date
	06/20/01
Wohnsitz	Residence
BOTTROP, DEUTSCHLAND	BOTTROP, GERMANY DEX
Staatsangehörigkeit	Citizenship
DEUTSCH	GERMAN
Postanschrift	Post Office Addess
HEIMERSFELD 91A	HEIMERSFELD 91A
46244 BOTTROP DEUTSCHLAND	46244 BOTTROP GERMANY
Voller Name des zweiten Miterfinders (falls zutreffend):	Full name of second joint inventor, if any.
Jürgen SANDKUHL	Jürgen SANDKUHL
Unterschrift des Erfinders Datum	Second Inventor's signature Date
Wohnsitz	Residence
WEYHE, DEUTSCHLAND	WEYHE, GERMANY
Staatsangehörigkeit	Citizenship
DEUTSCH	GERMAN
Postanschrift	Post Office Address
KIEFERNSTR. 1	KIEFERNSTR. 1
28844 WEYHE DEUTSCHLAND	28844 WEYHE GERMANY

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

3-00

Voller Name des dritten Miterfinders. ALFRED WAGENFELD	Full name of third joint inventor ALFRED WAGENFELD
Unterschrift des Erfinders Datum	Inventor's signature Date Alfred Wagenfeld 12.12.01
Wohnsitz SUESTEDT, DEUTSCHLAND	Residence SUESTEDT, GERMANY DEX
Staatsangehörigkeit DEUTSCH	Citizenship GERMAN ✓
Postanschrift IM STROH 5 27305 SUESTEDT DEUTSCHLAND	Post Office Address IM STROH 5 27305 SUESTEDT GERMANY
Voller Name des vierten Miterfinders	Full name of fourth joint inventor
Unterschrift des Erfinders Datum	Inventor's signature Date
Wohnsitz ,	Residence ,
Staatsangehörigkeit	Citizenship
Postanschrift	Post Office Address
Voller Name des fünften Miterfinders.	Full name of fifth joint inventor
Unterschrift des Erfinders Datum	Inventor's signature Date
Wohnsitz ,	Residence ,
Staatsangehörigkeit	Citizenship
Postanschrift	Post Office Address
Voller Name des sechsten Miterfinders:	Full name of sixth joint inventor
Unterschrift des Erfinders Datum	Inventor's signature Date
Wohnsitz ,	Residence ,
Staatsangehörigkeit	Citizenship
Postanschrift	Post Office Address

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

Declaration and Power of Attorney For Patent Application
Erklärung Für Patentanmeldungen Mit Vollmacht
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

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☒ am 20.06.2000 als
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and was amended on _____
(if applicable)

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(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein
			☐	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein
			☐	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein

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PCT/DE00/01980	20.06.2000		pending
(Application Serial No)	(Filing Date D, M, Y)	(Status)	(Status)
(Anmeldeserennnummer)	(Anmeldedatum T, M, J)	(patentiert, anhangig, aufgegeben)	(patented, pending, abandoned)
(Application Serial No)	(Filing Date D,M,Y)	(Status)	(Status)
(Anmeldeserennnummer)	(Anmeldedatum T, M, J)	(patentiert, anhangig, aufgeben)	(patented, pending, abandoned)

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

And I hereby appoint

Customer No. 30596

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Ext. _____

Postanschrift:

Send Correspondence to:

Harness, Dickey & Pierce, P.L.C.
12355 Sunrise Valley Drive, Suite 350 20191 Reston, Va.
Telephone: +1 703 390 3030 and Facsimile +1 703 390 3020

or

Customer No. 30596

Voller Name des einzigen oder ursprünglichen Erfinders	Full name of sole or first inventor
MICHAEL LUMM	MICHAEL LUMM
Unterschrift des Erfinders Datum	Inventor's signature Date
Wohnsitz	Residence
BOTTROP, DEUTSCHLAND	BOTTROP, GERMANY
Staatsangehörigkeit	Citizenship
DEUTSCH	GERMAN
Postanschrift	Post Office Addess
HEIMERSFELD 91A	HEIMERSFELD 91A
46244 BOTTROP DEUTSCHLAND	46244 BOTTROP GERMANY
Voller Name des zweiten Miterfinders (falls zutreffend).	Full name of second joint inventor, if any
Jürgen SANDKUHL	Jürgen SANDKUHL
Unterschrift des Erfinders Datum	Second Inventor's signature Date
2.12.2001	2.12.2001
Wohnsitz	Residence
WEYHE, DEUTSCHLAND	WEYHE, GERMANY DEX
Staatsangehörigkeit	Citizenship
DEUTSCH	GERMAN ✓
Postanschrift	Post Office Address
KIEFERNSTR. 1	KIEFERNSTR. 1
28844 WEYHE DEUTSCHLAND	28844 WEYHE GERMANY

2-00

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).